

highlight the impacts that could occur in Nevada, DOE has chosen to discuss them separately. DOE is looking at three transportation scenarios for Nevada. These scenarios include legal-weight truck and rail, which are the same as the national scenarios but highlight the Nevada portion of the transportation, and heavy-haul truck. The heavy-haul truck scenario includes the construction of an intermodal transfer station with associated highway improvements for heavy-haul trucks in the State. DOE has identified five potential rail corridors leading to Yucca Mountain and three potential intermodal transfer station locations with five associated potential highway routes for heavy-haul trucks. Section 2.1.3.3 describes these implementing alternatives.

2.1.1.5 Continuing Investigation of Design Options

As noted, this EIS describes and evaluates the flexible design concept for the repository and current plans for repository construction, operation and monitoring, and closure (see Section 2.1.2). DOE continues to investigate design options for possible incorporation in the final repository design; Appendix E identifies design features that DOE is considering for the final design (for example, specific design and operational considerations regarding natural ventilation and its duration; consideration of indefinite ventilation period; modular construction of repository facilities; whether to handle commercial spent nuclear fuel using a pool with water or a dry transfer system; and site access road construction). The criteria for selecting these design options are related to improving or reducing uncertainties in repository performance (the potential to provide containment and isolation of radionuclides) and operation (for example, worker and operational safety, ease of operation).

DOE has assessed each of the design options still being considered for the expected change it would have on short- and long-term environmental impacts and has compared these impacts to the potential impacts determined for the packaging, operating mode, and transportation scenarios evaluated in the EIS. This assessment, which is described in Appendix E, found that the changes in environmental impacts for the design options would be relatively minor in relation to the potential impacts evaluated in this EIS. Therefore, DOE has concluded that the analytical scenarios and implementing alternatives evaluated in this EIS provide a representative range of potential environmental impacts the Proposed Action could cause. Chapter 9 discusses mitigation from design options that could be beneficial in reducing impacts associated with repository performance or operation.

2.1.2 REPOSITORY FACILITIES AND OPERATIONS

This section describes proposed repository surface and subsurface facilities and operations (Sections 2.1.2.1 and 2.1.2.2), the performance confirmation program (Section 2.1.2.3), and repository closure (Section 2.1.2.4). The description is based on the Science and Engineering Report (DIRS 153849-DOE 2001, all) and other engineering data files (DIRS 104508-CRWMS M&O 1999, all; DIRS 104523-CRWMS M&O 1999, all; DIRS 102030-CRWMS M&O 1999, all) unless otherwise noted. The following paragraphs contain an overview of the repository facilities and operations and the sequence of planned repository construction, operation and monitoring, and closure. DOE would design the repository based on the extensive information collected during the Yucca Mountain site characterization activities. These activities are summarized in semiannual site characterization reports. [See the semiannual Site Characterization Progress Reports that the Department prepares in accordance with Section 113(b)(3) of the NWSA (for example, DIRS 155982-DOE 2001, all).] The facilities used for site characterization activities at Yucca Mountain would be incorporated in the repository design to the extent practicable. (See Chapter 3, Section 3.1, for additional information on existing facilities at Yucca Mountain developed during site characterization activities.)

DOE would construct surface facilities at the repository site to receive, prepare, and package spent nuclear fuel and high-level radioactive waste for underground emplacement. In addition, surface

facilities would support the construction of subsurface facilities. These facilities include the following primary surface operations areas:

- North Portal Operations Area – Receive, prepare, and package spent nuclear fuel and high-level radioactive waste for underground emplacement
- South Portal Development Area – Support the construction of subsurface facilities
- Ventilation Shaft Operations Area – Supply air to and exhaust air from the subsurface facilities

Figure 2-7 is an aerial photograph of the Yucca Mountain site showing the locations of these surface facilities. The spent nuclear fuel and high-level radioactive waste would be handled remotely with workers shielded from *exposure* to radiation using design and operations practices in use at licensed nuclear facilities to the maximum extent practicable. The repository operations areas and supporting areas, utilities, roads, etc., would require the active use of as much as 6 square kilometers (1,500 acres) of land. Of this total area, about 1.5 square kilometers (370 acres) have been disturbed by previous activities.

Figure 2-8 shows the subsurface layout of the repository, which would consist of drifts (tunnels) and vertical ventilation shafts that DOE would excavate in the mountain. Along with the main drifts, gently sloping ramps from the surface to the subsurface facilities would move workers, equipment, and waste packages. Waste packages of spent nuclear fuel and high-level radioactive waste would be placed in the emplacement drifts. The ventilation systems would move air for workers and would cool the repository.

The following paragraphs contain an overview of the sequence of repository construction, operation and monitoring, and closure. Figure 2-9 shows the timing assumed for analysis, site recommendation, site designation, licensing review, construction, operation and monitoring, and closure of the proposed repository at Yucca Mountain. If the Yucca Mountain site was recommended for development as a repository, DOE would continue performance confirmation activities to support a License Application to the Nuclear Regulatory Commission in accordance with the NWP. Performance confirmation activities after Site Recommendation and before the construction of performance confirmation drifts could be similar to activities performed during site characterization. These activities could require surface excavations and borings, subsurface excavations and borings, and in-place testing of rock characteristics.

The construction of repository facilities for the handling of spent nuclear fuel and high-level radioactive waste would begin after the receipt of construction authorization from the Nuclear Regulatory Commission. DOE assumed that construction would begin in 2005. The repository surface facilities, the main drifts, ventilation system, and initial emplacement drifts would be built in approximately 5 years, from 2005 to 2010 (DIRS 153849-DOE 2001, Section 2.3.5.1.1).

Repository operations would begin after DOE received a license amendment from the Nuclear Regulatory Commission to receive and possess spent nuclear fuel and high-level radioactive waste. For analytical purposes, DOE assumed that the receipt and emplacement of these materials would begin in 2010 and would occur over a 24-year period, unless DOE used aging to implement the lower-temperature repository operating mode. With aging, the emplacement period would be 50 years. DOE also assumed that material receipt would occur at a rate of approximately 3,000 MTHM per year. The emplacement rates discussed here are estimated for analytical purposes only, and would need to be refined should a repository be constructed.

The construction of emplacement drifts would continue for 22 years during emplacement, or would continue until near the end of aging if aging was used to achieve the lower-temperature repository operating mode. The repository design would enable simultaneous construction and emplacement

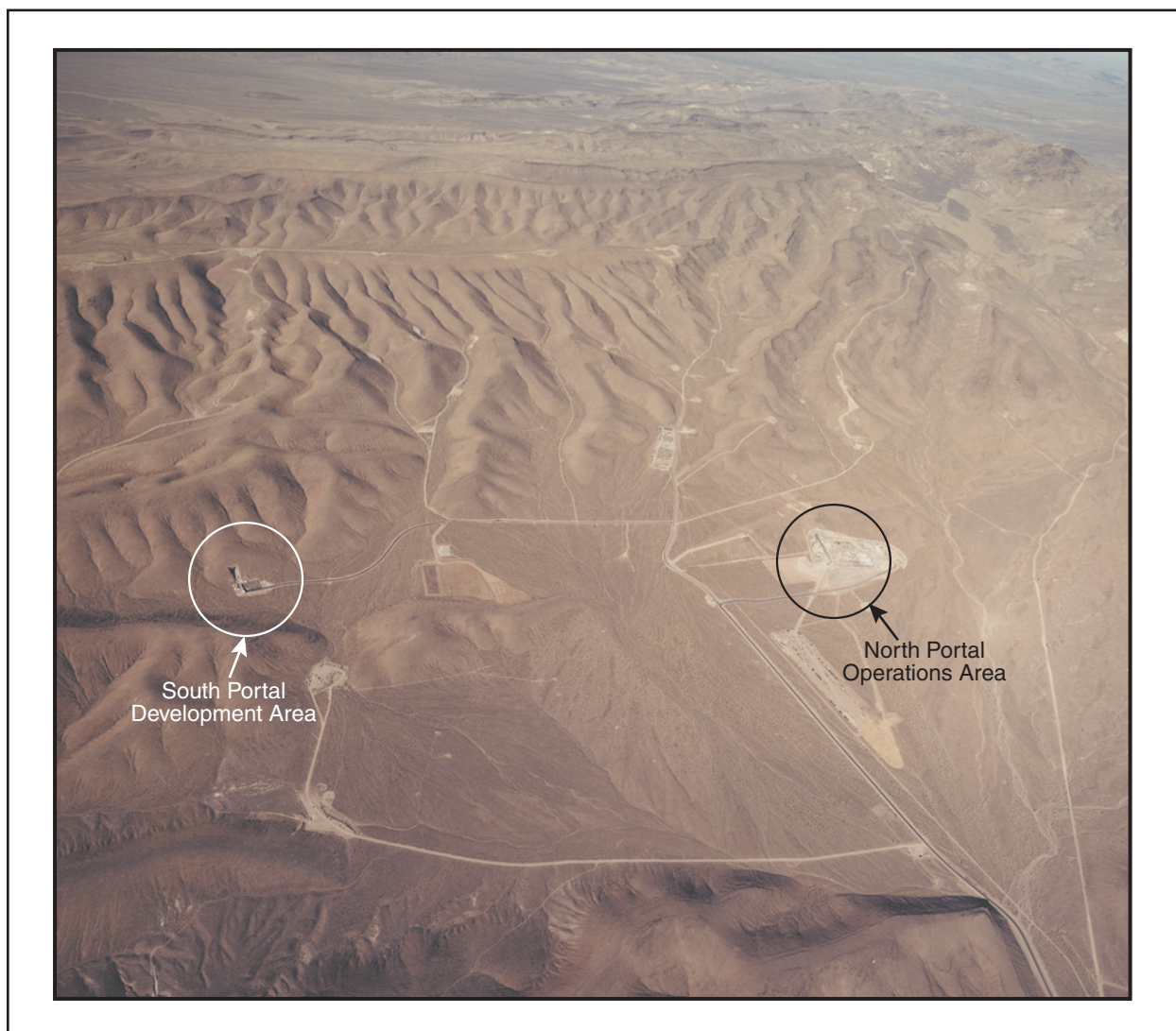


Figure 2-7. Surface facilities at the proposed Yucca Mountain Repository.

operations, and would physically separate activities on the construction or development side of the repository from activities on the emplacement side. This would provide protection of workers and appropriate ventilation of the emplaced waste.

Monitoring and maintenance activities would start with the first emplacement of waste packages and would continue through repository closure. After the completion of emplacement, DOE would maintain those repository facilities, including the ventilation system and utilities (air, water, electric power) that would enable continued monitoring and inspection of the emplaced waste packages, continued investigations in support of estimates of long-term repository performance, and the *retrieval* of waste packages if necessary. Immediately after the completion of emplacement, DOE would decontaminate and close the surface facilities that handled nuclear materials to eliminate any potential radioactive material release and would place surface facilities in a standby condition. That is, they could be reactivated if necessary. DOE would maintain an area in the Waste Handling Building for the possible testing of waste packages as a quality assurance contingency in the performance confirmation program. Future generations would decide whether to continue to maintain the repository in an open, monitored condition or to close it. To ensure flexibility to future decisionmakers, the EIS analyzed the repository with the capability for closure as early as 50 years or as late as 324 years after the start of emplacement based on

example scenarios in the Science and Engineering Report (DIRS 153849-DOE 2001, Section 2.1.5). As stated in the Science and Engineering Report, for the higher-temperature repository operating mode, the start of closure could occur as early as 50 years after initial emplacement. The EIS analysis of the higher-temperature operating mode assumes that closure would begin 100 years after the start (76 years after the completion) of emplacement to facilitate comparisons. The lower-temperature repository operating mode would require a longer period of ventilation. This EIS evaluates closure of the repository in the lower-temperature mode after forced ventilation for as many as 324 years after the start of emplacement.

The performance confirmation program would continue some of the activities initiated during site characterization until repository closure, including various types of tests, experiments, and analytical procedures. DOE would conduct performance confirmation activities to further evaluate the accuracy and adequacy of the information used to demonstrate compliance that the repository would meet performance objectives.

Throughout the construction, operation, monitoring and maintenance, and closure periods, the repository would remain under effective institutional control. Under institutional control, the repository would be maintained to ensure that workers and the public were protected adequately in compliance with applicable Federal regulations and the requirements in DOE Order 5400.5 “Radiation Protection of the Public and the Environment.”

Repository closure would occur after DOE received a license amendment from the Nuclear Regulatory Commission. Closure would take about 10 years for the higher-temperature repository operating mode (DIRS 150941-CRWMS M&O 2000, p. 6-22), and from 11 to 17 years for the lower-temperature repository operating mode. Closure of the repository facilities would include emplacing the drip shields, closing the subsurface facilities, completely decontaminating and decommissioning the surface facilities, reclaiming the disturbed surface areas, and establishing long-term institutional controls, including land records and warning systems to limit or prevent intentional or unintentional activity in and around the closed repository. DOE would establish a postclosure monitoring program, as required by Section 801(c) of the Energy Policy Act of 1992 (Public Law 102-486, 106 Stat. 2776); the Nuclear Regulatory Commission has regulations (10 CFR Part 63) addressing postclosure monitoring.

2.1.2.1 Repository Surface Facilities and Operations

Surface facilities at the repository site would receive, prepare, stage, and package spent nuclear fuel and high-level radioactive waste for subsurface emplacement. In addition, they would support the construction of the subsurface facilities. DOE would upgrade some surface facilities built for site characterization, but most would be new. Most facilities would be in three areas—the North Portal Operations Area, the South Portal Development Area, and the Ventilation Shaft Operations Areas. Facilities to support waste emplacement would be concentrated near the North Portal, and facilities to support subsurface facility development would be concentrated near the South Portal. The following sections describe these areas in more detail. In addition, Section 2.1.2.1.4 describes support facilities and utilities.

2.1.2.1.1 North Portal Operations Area

This area, shown in Figure 2-10, would be the largest of the primary operations areas, covering about 0.6 square kilometer (150 acres) (DIRS 104508-CRWMS M&O 1999, Section 4.2.3.1) at the North Portal. It would include two areas: a *Radiologically Controlled Area* for receipt, handling, and packaging of spent nuclear fuel and high-level radioactive waste prior to emplacement, and a Balance of Plant Area for support services (such as administration, training, and maintenance). The Radiologically Controlled Area would be monitored to ensure adequate safeguards and security for radioactive materials. The two